

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 23 JUN 2005

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| Applicant's or agent's file reference 2003P01122WO | FOR FURTHER ACTION | | See Form PCT/PEA/416 |
| International application No. PCT/GB2004/000369 | International filing date (day/month/year) 29.01.2004 | Priority date (day/month/year) 29.01.2003 | |
| International Patent Classification (IPC) or national classification and IPC H04Q7/38 | | | |
| Applicant ROKE MANOR RESEARCH LIMITED et al | | | |

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

3. This report is also accompanied by ANNEXES, comprising:

a. ☒ sent to the applicant and to the International Bureau) a total of 10 sheets, as follows:

☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒ Box No. I Basis of the opinion

☐ Box No. II Priority

☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability



☐ Box No. IV Lack of unity of invention

☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

☐ Box No. VI Certain documents cited

☐ Box No. VII Certain defects in the international application

☐ Box No. VIII Certain observations on the international application

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|---|--|
| Date of submission of the demand 29.11.2004 | Date of completion of this report 21.06.2005 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | Authorized Officer Pasini, E Telephone No. +49 89 2399-6968  |

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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

| | |
|---------|----------------------------------|
| 1, 8-23 | as originally filed |
| 2, 4-7 | filed with telefax on 29.11.2004 |
| 3, 3a | filed with telefax on 24.02.2005 |

Claims, Numbers

| | |
|------|----------------------------------|
| 1-14 | filed with telefax on 24.02.2005 |
|------|----------------------------------|

Drawings, Sheets

| | |
|---------|---------------------|
| 1/4-4/4 | as originally filed |
|---------|---------------------|

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 11, 12, 13, 14

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 11, 12, 13, 14 are so unclear that no meaningful opinion could be formed (*specify*):

see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos.

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form

☐ has not been furnished

☐ does not comply with the standard

the computer readable form

☐ has not been furnished

☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See separate sheet for further details

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------|
| Novelty (N) | Yes: Claims | 1-10 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-10 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-10 |
| | No: Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

Cited Documents

The following documents are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1: WO 00/28760 A2

D2: US 6181686 B1

D3: US 2002/0164980 A1

D4: ETSI TS 143 051 V5.7.0 (2002-08) : Digital cellular telecommunications system (Phase 2+); GSM/EDGE Radio Access Network (GERAN) overall description,; Stage 2 (3GPP TS 43.051 version 5.7.0 Release 5); pages 1-44

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The subject-matter of **claim 11** is defined merely by a reference to the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here. The expression "substantially as described and/or as illustrated in the accompanying drawing" in independent **claim 11** leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT and Guideines 5.10.
2. **Claim 12** (directed to a communications system) refers to the "method of any preceding claim". **Claim 13** (directed to a network) and independent **claim 14** (directed to a mobile station) refer to the "method of any of **claims 1-11**". Consequently, the same objection as made in paragraph 1 above is also valid for **claims 12, 13 and 14**, since their subject-matter is defined by a reference to the unclear (Article 6 PCT) subject-matter of **claim 11**.
3. The expression "arranged within a communication system according to **claim 12**" in **claim 13** does not clearly (Article 6 PCT) define the features of the claimed network. Furthermore, since **claim 12** also defines the feature of a network arranged to perform the method of any of the preceding **claims 1-11**, the expression "arranged

within a communication system according to **claim 12**" in **claim 13** is also unclear because the subject-matter of **claim 13** itself already explicitly refers to the "method of any of **claims 1-11**".

4. The same objections as made in paragraph 3 above in respect of the unclear formulation "arranged within a communication system according to **claim 12**" are also valid for **claim 14**.
5. As a consequence, **claims 11 to 14** are so unclear in their present form that no meaningful opinion could be formed on novelty and inventive step in respect of their subject-matter (Article 34(4)(a)(ii) PCT).

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

A. Novelty / Inventive Step:

1. The present invention relates to a method for selecting a transport format combination according to **claim 1**.

A method for selecting a transport format combination TFC to be used for communication from the mobile station to the network over a channel of variable quality is known from **document D1**.

D1 (page 1, line 5 to page 17, line 21) discloses the steps of defining a set of possible transport format combinations, calculating a channel quality requirement for the effective use of each transport format combination, indicating the transport format combinations and the channel quality requirements to the mobile station and in the mobile station storing the transport format combinations and relative channel quality requirements and selecting one of the transport format combinations having a requirement no greater than the existing channel quality and informing the network of the selected transport combination.

Furthermore, document **D2** (column 1, line 1 to column 2, line 61; column 3, lines 28 to column 4, line 5; column 4, lines 29-31; column 5, line 65 to column 6, line 8; column 8, lines 19-25) discloses the features of calculating an existing quality of the channel of variable quality, indicating the existing quality of the channel of variable quality to the mobile station and in the mobile station receiving the indication of existing channel quality. In particular, in **D2** the indication to the mobile station is done using SACCH channel messages.

2. A main **disadvantage** related to the known method for selecting a transport format combination TFC is that the indication to the mobile station do not provide fast adaptation to variations in the channel conditions.
3. The present invention overcomes this disadvantage by providing a method for selecting a transport format combination according to the features of **claim 1**.

According to the **essential features of the invention**, the method for selecting a transport format combination comprising the definition of a set of transport format combinations with the respective channel quality requirement and with indication of the existing quality to the mobile station **further comprises** the features that the indication of the existing quality of the channel of variable quality is communicated to the mobile station by inband signalling, whereby the indication of the existing quality of the channel is included in every downlink radio packet in data locations normally assigned for carrying user information.

4. The usage of inband signalling according to the present invention provides the **advantage** of very fast adaptation to the uplink channel conditions because the indication of existing channel quality, and thus of the allowed TFCs, could be signalled to the mobile station with every downlink radio packet.
5. The subject-matter of the present invention as claimed in independent **claim 1** is neither disclosed in, nor rendered obvious by the **remaining prior art documents** cited in the international search report.
6. Thus, the subject-matter of **claim 1** is considered to be **new** and to involve an

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inventive step (Articles 33(2) and 33(3) PCT).

7. As dependent **claims 2 to 10** are dependent on **claim 1**, **claims 2 to 10** do also meet the requirements of the Articles 33(2) and 33(3) PCT.

B. Further remarks made in respect of the present application:

Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, Rule 6.2(b) PCT.

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whether the complete file takes a long time to arrive at its destination. On the other hand, when transmitting voice data, it is important that the data arrive with as short a delay as possible, whereas the loss of occasional data is relatively unimportant. Control signalling between the mobile station and the network, on the other hand, must be received quickly and accurately. Similar criteria could be defined for other data types.

For example, control data, voice and video data may be multiplexed together into a single radio block, and all data types may meet the requirements for quality and timely delivery. Should the uplink quality degrade, it may no longer be possible to transmit all of these types of data together. A decision will need to be taken as to whether to transmit, for example, just the control data, the control data and the video data or the control data and the voice data.

In known versions of FLO, the transmitter sends, together with the data, a TFCI (Transport Format Combination Indicator) signal to the receiver, to inform it of the particular Transport Format Combination (TFC), i.e. combination of data types, that has been used during transmission. A major drawback with this system is that the TFC to be used by the mobile station cannot be selected by the network, as the network is unaware of the types and quantity of each data type that the mobile station has to transmit. Therefore, it is desirable that the mobile station should be involved in deciding the data transmission format to be used.

In the UTRAN system, the scheduling of uplink data is under the control of the mobile station. Further details may be found in 3GPP TS 25.133, 3GPP TS 25.321 and 3GPP TS 25.331, available from the internet site www.3gpp.org. The mobile station handles the dynamic control of the uplink formatting, although the base station has the possibility to limit the selection available to the mobile station in a semi-static fashion. The TFC to be used in the uplink will to some extent depend on the conditions of the radio channel. The system is arranged such that the base station receives equal signal power from all mobile stations. Voice, data and other services have different power requirements which may be accommodated within a fixed received power level. The power transmitted by the mobile station is adjusted, by means of a feedback loop, so that the power received by the base transceiver station (BTS or Node B) is approximately constant, equal to a value set by the

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network. For the UTRAN system, this feedback loop may operate at a speed of 1500Hz. This enables the mobile station to obtain an estimate of the uplink channel conditions from the transmit power commanded by the network, offering effective TFC adaptation to uplink channel conditions. However, the corresponding feedback loop in 5 GSM/GERAN operates only at approximately 2Hz. This is too slow for effective TFC adaptation to uplink channel conditions. Therefore, a system similar to that used in the UTRAN system could not be used in the GSM / GERAN system. A criterion based on the estimated mobile station transmit power, as used for UTRAN, is suitable for a CDMA system (where power is the common shared resource) but would not work in a TDMA system such 10 as GSM/GERAN. Therefore, different criteria need to be defined for the GSM/GERAN mobile station to decide whether a TFC is available for use or not.

The present invention accordingly seeks a method for providing an effective mechanism to enable a mobile station to select an appropriate transport format combination (TFC) based on 15 uplink channel conditions.

For Flexible Layer One (FLO) operation in GSM/GERAN, it has been agreed in 3GPP that the TFC to be used in the uplink is selected by the mobile station. However, in order to select the best TFC during every Transmission Time Interval (TTI), the mobile station should have 20 an estimate of the radio channel conditions, such as the channel-to-interference ratio CIR. The problem is that the channel conditions in the uplink are not known to the mobile station, but only to the network. Therefore, in the algorithm proposed in this application for the GERAN, the mobile station will need to rely on assistance provided by the network to perform a selection.

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A somewhat similar scheme for application to UTRAN communication systems is described in Tdoc R1-02-1277 presented at the TSG-RAN WG1 #29 meeting in November 2002 and available from the internet site www.3gpp.org.

30 International Patent Application WO 00/28760 A2 described a system wherein allowed transport format combinations are selected by the network and identified to a mobile station.

3a

The mobile station may request a change of allowed transport format combination, which the network may choose to allow.

In US Patent 6,181,686, a measurement of uplink quality is sent to the mobile station. The
5 mobile station can use this information to decide whether a change of data transfer mode is needed.

US patent application 202/0164980 describes a radio communication apparatus, with a flexibly configurable layer over transport channels

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The invention accordingly provides, in a mobile communications system comprising a network and at least one mobile station, a method for selecting a transport format

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combination TFC to be used for communication from the mobile station to the network, over a channel of variable quality. The method comprises the steps of, in the network:

- a) defining a set of possible transport format combinations;
- b) calculating a channel quality requirement for the effective use of each transport
5 format combination;
- c) — indicating the transport format combinations and the channel quality requirements to the mobile station;
- d) calculating an existing quality of the channel of variable quality; and
- e) indicating the existing quality of the channel of variable quality to the mobile station;
10 and, in the mobile station;
- f) storing the transport format combinations and relative channel quality requirements;
- g) receiving the indication of existing channel quality;
- h) selecting one of the transport format combinations having a channel quality requirement no greater than the existing channel quality, and
15 i) informing the network of the selected transport combination.

The indication of the existing quality of the channel of variable quality is communicated to the mobile station by inband signalling, whereby the indication of the existing quality of the channel of variable quality is included in every downlink radio packet, in data locations
20 normally assigned for carrying user information.

The step (h) of selecting one of the transport format combinations may be performed with regard to the type of data to be transmitted by the mobile station.

25 The transport format combinations preferably enable transmission of data blocks containing data from different TBFs in each block.

Calculation of the existing quality of the channel of variable quality may be performed periodically during communication.

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- 5 -

The relative channel quality may be calculated as the minimum channel quality required such that data sent on the channel is received with an error ratio below a defined threshold.

The step (c) of indicating transport format combinations and channel quality requirements to the mobile station may include the steps of:

- (c1) ranking the transport format combinations according to the associated channel quality requirement; and
- (c2) indicating the rank (TFCI) of each transport format combination to the mobile station, along with the transport format combinations themselves, to the mobile station. The step (c2) of indicating the rank of each transport format combination may comprise indicating the transport format combinations themselves in order of increasing, or decreasing, rank. The step of indicating the existing quality of the channel of variable quality comprises indicating the rank of the transport format combination having the highest channel quality requirement, which could effectively be employed on the channel in its existing quality. The rank may be indicated as an absolute value. Alternatively, The rank may be indicated as a relative value, being an offset relative to a previous value of the rank.

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The present invention also provides a communications system arranged to operate according to the method described. The present invention also provides a network arranged to operate 5 within such a communications system. The present invention also provides a mobile station arranged to operate within such a communications system.

The above, and further, objects characteristics and advantages of the present invention will become more apparent from consideration of the following description of certain 10 embodiments, given by way of examples only, with reference to the accompanying drawings, wherein:

Fig. 1 schematically shows the allocation of transport format combination identifiers (TFCIs) to transport format combinations (TFC), and the indication of one TFCI defining a range of allowed TFCs;

15 Fig. 2 shows results of simulations showing a comparison of user data throughput for various alternative signalling methods according to certain embodiments of the present invention, assuming acknowledged mode operation of the radio link control (RLC);

Fig. 3 shows results of simulations showing a comparison of SDU FER (service data unit frame erasure rate) for various signalling mechanisms according to certain embodiments of

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the present invention, assuming acknowledged mode operation of the radio link control (RLC);

Fig. 4 shows results of simulations showing a comparison of user data throughput for various alternative signalling methods according to certain embodiments of the present invention, assuming unacknowledged mode operation of the radio link control (RLC);

Fig. 5 shows results of simulations showing a comparison of SDU FER (service data unit frame erasure rate) for various signalling mechanisms according to certain embodiments of the present invention assuming unacknowledged mode operation of the radio link control (RLC); and

10 Fig. 6 schematically shows a ~~the~~ current format of radio packet for the Flexible Layer One before the operation of interleaving, and a new format detailing a possible position of the inband bits, according to an embodiment of the invention.

A basic description of an example of the invention follows. A background description of TFC selection is available in 3GPP TR 45.902, presented at 3GPP TSG GERAN#15 in June 15 2003 and available from the internet site www.3gpp.org.

1. The network configures a set of possible service mixes – transport format combinations (TFCs) – and signals these to the mobile station. When defining the transport format combination set (TFCS), the TFCs are ranked according to the radio conditions or signal quality required to achieved the specified quality of service. For example, the requirement could be that, with the current radio conditions, the transport blocks sent on all the transport channels (TrCHs) included in the TFC are received with a block error ratio (BLER) lower than a specified value, e.g. 1%. Accordingly, the higher the TFCI, the better the quality of the radio link required. This could be characterised, for example, in terms of the received power level (RXLEV), bit error probability (BEP), the block error ratio (BLER) on the different transport channels, or other parameters.

2. The ranking is communicated to the mobile station at call set-up by means of the order in which they are signalled in the assignment message: the TFCs are signalled in the assignment message in increasing order of quality of the link required. It has been agreed to use in the GERAN system the same mechanism that is used in

CLAIMS

1. In a mobile communications system comprising a network and at least one mobile station, a method for selecting a transport format combination TFC to be used for communication from the mobile station to the network, over a channel of variable quality, the method comprising the steps of:

in the network,

- a) defining a set of possible transport format combinations;
 - b) calculating a channel quality requirement for the effective use of each transport format combination;
 - c) indicating the transport format combinations and the channel quality requirements to the mobile station;
 - d) calculating an existing quality of the channel of variable quality; and
 - e) indicating the existing quality of the channel of variable quality to the mobile station;
 - f) storing the transport format combinations and relative channel quality requirements;
 - g) receiving the indication of existing channel quality;
 - h) selecting one of the transport format combinations having a channel quality requirement no greater than the existing channel quality, and
 - i) informing the network of the selected transport combination,
- characterised in that the indication of the existing quality of the channel of variable quality is communicated to the mobile station by inband signalling, whereby the indication of the existing quality of the channel of variable quality is included in every downlink radio packet, in data locations normally assigned for carrying user information.

2. A method according to claim 1 wherein the step h of selecting one of the transport format combinations is performed with regard to the type of data to be transmitted by the mobile station.

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3. A method according to claim 1 or claim 2, wherein the transport format combinations enable transmission of data blocks containing data from different Temporary Block Flows in each block.

5 4. A method according to any preceding claim wherein calculation of the existing quality of the channel of variable quality is performed periodically during communication.

5. A method according to any preceding claim, wherein the relative channel quality is calculated as the minimum channel quality required such that data sent on the channel is
10 received with an error ratio below a defined threshold.

6. A method according to any preceding claim wherein the step c of indicating transport format combinations and channel quality requirements to the mobile station includes the steps of:

15 (c1) ranking the transport format combinations according to the associated channel quality requirement; and

(c2) indicating the rank of each transport format combination to the mobile station, along with the transport format combinations themselves, to the mobile station.

20 7. A method according to claim 6, wherein the step c2 of indicating the rank of each transport format combination comprises indicating the transport format combinations themselves in order of increasing, or decreasing, rank.

8. A method according to claim 6 or claim 7 wherein the step of indicating the existing
25 quality of the channel of variable quality comprises indicating the rank of the transport format combination having the highest channel quality requirement, which could effectively be employed on the channel in its existing quality.

9. A method according to claim 8, wherein the rank is indicated as an absolute value.

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10. A method according to claim ²⁶8 wherein the rank is indicated as a relative value, being an offset relative to a previous value of the rank.
- 5 11. A method substantially as described and/or as illustrated in the accompanying drawings.
12. A communications system comprising a network and a mobile station, respectively comprising means for carrying out the steps of, and arranged to perform, the method of any
10 preceding claim.
13. A network comprising means for carrying out the respective steps of the method of any of claims 1 – 11 and arranged within a communications system according to claim 12.
- 15 14. A mobile station comprising means for carrying out the respective steps of the method of any of claims 1 – 11 and arranged within a communications system according to claim 12.